Landsat Global Land Cover (GLC) Essential Climate Variable Introductory Project Summary

Overview

Land cover change is increasingly affecting the biophysics, biogeochemistry, and biogeography of the Earth's surface and atmosphere, with far-reaching consequences to human well-being. However, our scientific understanding of the distribution and dynamics of land cover and land cover change (LCLCC) is limited. Previous global land cover assessments performed using coarse spatial resolution (300 m – 1 km) satellite data produced a global perspective on LCLCC, but did not provide enough thematic detail or change information for local, regional or global change studies, nor for resource managers. Even though high resolution (<= 30 m) global land cover data derived from the 40 year Landsat record are desirable, until recently there were a number of challenges to overcome including data cost , consistent global coverage, data volume, shortcomings in pre-processing and interpretation algorithms, availability of training and validation data, and high-computing needs.

To address this need, U. S. Group on Earth Observations (GEO), announced during the GEO Ministerial Summit in Beijing in November 2010, that the United States is launching a new global land change monitoring initiative. Following the announcement researchers from the USGS/EROS, University of Maryland, State University of New York, and other collaborators joined forces to implement the project. This research builds on previous USGS studies on:

1. Global Land Cover Characterization http://edc2.usgs.gov/glcc/glcc.php
2. Global Mangrove Forest Dynamics http://lca.usgs.gov/lca/globalmangrove/index.php

The aim of the project is to develop the first-ever comprehensive and up-to-date land cover and land cover change database of the world at 30 meter spatial resolution using Landsat satellite data. Specific research objectives of the project are to (i) produce global land cover estimates of percent tree, percent bare ground, percent other vegetation, and percent water presence for 2000 and 2010 at nominal 30 m resolution; (ii) develop an initial global land cover (type) baseline for the 2010 period; (iii) implement an ongoing monitoring system that provides periodic (annually, biennially, and quinquennially) land cover updates and change products; (iv) improve the availability and accessibility of 30m class satellite data (whenever possible); and (v) establish the capability and capacity to develop historical land change time series (1970s to present).

Global land cover data at 30 m spatial resolution will be a great leap forward for the following reasons:

- (i) It will enable detection of land change at the scale of most human activity;
- (ii) It offers increased flexibility for environmental model parameterization;
- (iii) It will provide spatial information content hundreds of times better than existing global land cover data sets;
- (iv) It will support many GEO tasks and activities including GEO Agriculture, Forest Carbon Tracking, the Biodiversity Observation Network, and the Land Cover Task; and

(v) It will meet the requirement of resource managers and the global change research community because of higher spatial and thematic detail.

(vi) Finally, it will do all of these things with the detail to provide locally relevant information and the consistency to tie these local processes together globally.

Global land cover monitoring at 30 m is possible due to the availability of Landsat or similar resolution satellite data at the global scale and at no cost to the user. Landsat is the only satellite that ensures land cover change analysis retrospectively and prospectively because of its acquisition, processing, and distribution strategies. For example, Landsat is the only satellite observation that provides a continuous global record of the Earth's surface dating back to 1970s.

Without validation, global land cover datasets remain untested hypotheses and as such do not meet the requirements of the user community. The project team is validating the global land cover datasets using 500 5x5 km sample frames. Reference data for the sample frames are produced via classification of commercial high resolution data (ranging from 0.5 - 4m). Thematic classification are produced iteratively using a decision tree classifier performed on composite imagery comprised of sensor spectral bands and numerous vegetation and textural indices, as well as rigorous analyst interpretation and review. The validation results will be aggregated to the 30 m resolution of the VCF data to produce comparable estimates of percent tree cover at Landsat resolution.

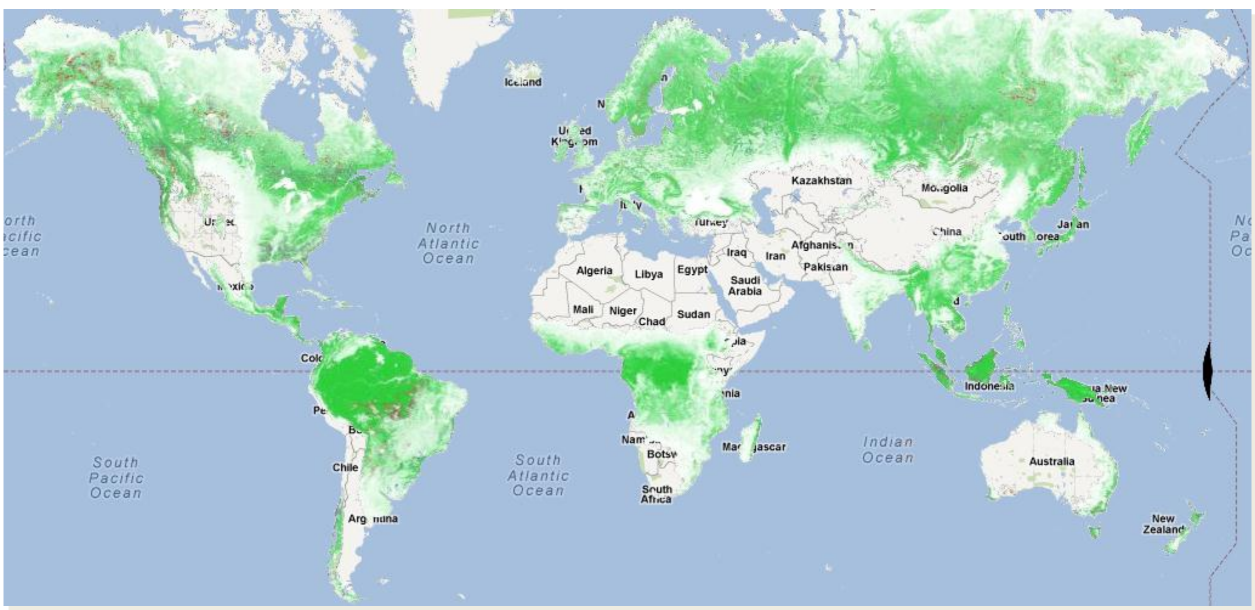

Figure: A 960 m test product for percent tree cover, gain and loss, 1999 to 2011, white-to-green scale: tree canopy cover (0-100%); Red - tree cover loss; Blue - tree cover gain; Violet - tree cover loss followed by tree cover gain.

Figure: One of the 5x5 km validation sites in Sao Paulo, Brazil for the year 2010. Data acquired from National Geospatial Intelligence Agency (NGA) Web-based Access and Retrieval Portal (WARP) https://warp.nga.mil

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Publications

Giri, C.P., ed., 2012, Remote sensing of land use and land cover—principles and applications: Boca Raton, Fla., CRC Press,477 p. (Also available online at http://www.crcnetbase.com/isbn/9781420070743.),

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Thenkabail P.S., Knox J.W., Ozdogan, M., Gumma, M.K., Congalton, R.G., Wu, Z., Milesi, C., Finkral, A., Marshall, M., Mariotto, I., You, S. Giri, C. and Nagler, P. 2012. Assessing future risks to agricultural productivity, water resources and food security: how can remote sensing help?. Photogrammetric Engineering and Remote Sensing, August 2012 Special Issue on Global Croplands: Highlight Article, August 2012 pp:773-782

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Giri. C, Ochieng. E, Tieszen. L. L, Zhu. Z, Singh. A, Loveland. T, Duke. N. 2011. Status and distribution of mangrove forests of the world using earth observation satellite data**.** *Global Ecology and Biogeography*, 20(1):154-159.

Contact Us

http://landsat.usgs.gov/contactus.php

Links

Mathews Global Vegetation/Land Use	**http://www.giss.nasa.gov/**
Olson Land Cover and Vegetation	http://www.grid.unep.ch/
Willson and Henderson–Sellers Global Land Cover	http://www.ngdc.noaa.gov/
DeFries/Townshend-Global Land Cover	http://glcf.umiacs.umd.edu/
GLCC (IGBP DISCover)	http://edcdaac.usgs.gov/
UMD Land Cover	http://glcf.umiacs.umd.edu/

MODIS Land Cover	http://edcdaac.usgs.gov/
Vegetation Continuous Fields	http://glcf.umiacs.umd.edu/
GLC-2000	http://www.gvm.sai.jrc.it/
Vegetation Continuous Fields	http://glcf.umiacs.umd.edu/
GLOBCOVER	http://www.esa.int/
MODIS Land Cover	http://lpdaac.usgs.gov/
GeoCover LCTM	http://www.earthsat.com/
China Global Land Cover	http://www.globallandcover.com/
GEO US Global Land Cover	http://landcover.usgs.gov/